Bulletin 366 January, 1935

REPORT OF THE DIRECTOR

For the Year Ending

October 31, 1934

Connecticut
Agricultural Experiment Station
New Haven

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

(As of October 31, 1934)

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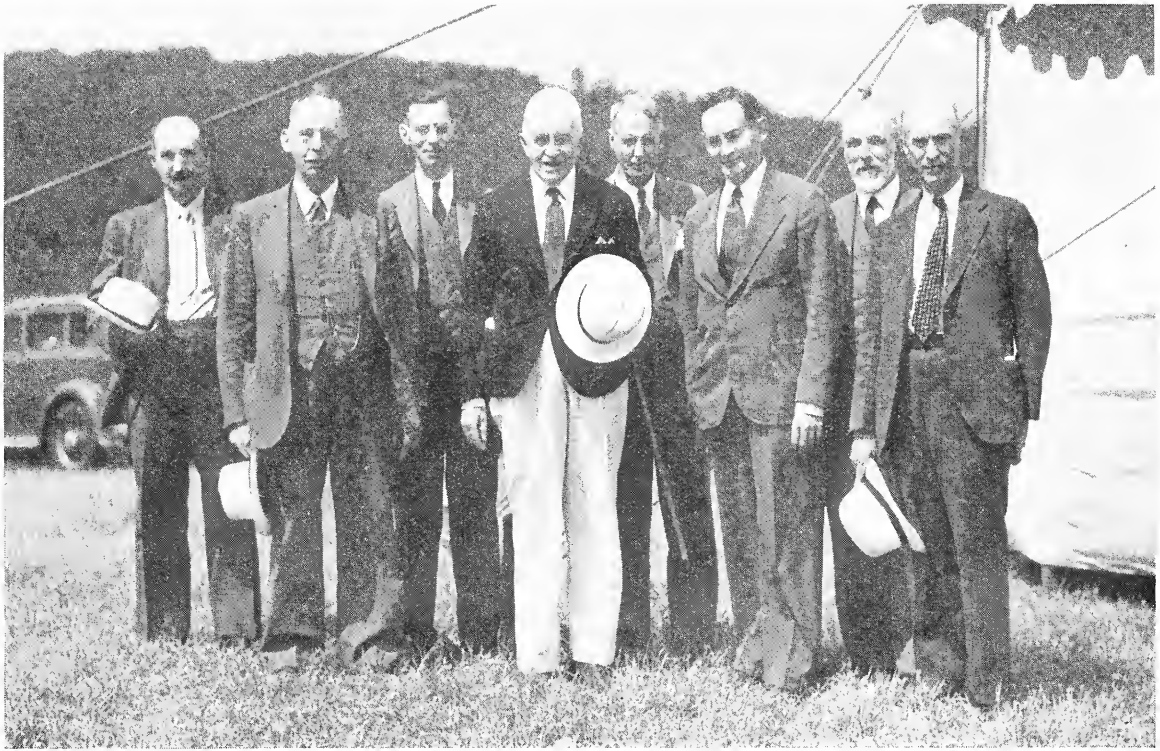

STATION FIELD DAY, AUGUST 22, 1934

Members of the Station Board and Dr. Ezekiel, the speaker, are standing outside the big tent at the experiment farm at Mount Carmel. They are (left to right): A. B. Plant, Elijah Rogers, Director Slate, Governor Cross, Olcott King, Dr. Ezekiel, Charles G. Morris and E. C. Schneider.

REPORT OF THE DIRECTOR

For the Year Ending October 31, 1934

To the Board of Control of the Connecticut Agricultural Station:

WHATEVER may have been the experience in other groups, the past year has been one of cheerfulness and enthusiasm at the Station. In spite of reduced budgets and salaries, our work has gone well and quite smoothly. Perhaps this is the reflection of the better feeling generally prevalent among farmers; it may be due in part to the opportunity for driving certain slow-moving projects toward completion through the help of federal relief agencies. Whatever the cause, the effect has been to clear the skies and give us a renewed faith in the task of "putting science at work for agriculture".

The place of the Station in the affairs of the State has been re-emphasized, not only in the minds of the staff, but in the consciousness of the general public. Established primarily to serve agriculture, it has come to serve all citizens as a source of scientific information on a great variety of matters, both public and private. It has the advantage of maintaining a permanent body of scientists accumulating data on the problems of farmer and consumer over a long period of time. Thus in emergencies, no time is lost while new agencies or men familiarize themselves with a situation. The Station is ready to serve.

Recent illustrations are furnished in the cases of the Dutch elm disease, the soil testing service, the "X" disease of peaches and the expanded mosquito elimination project, discussed in more detail elsewhere in this report. Not that all questions can be answered when they arise. There is much yet to be learned about most problems, but we are in a strategic position. With no "program" to promote or carry out, with long experience in fact-finding, the Agricultural Station is unique among public institutions.

However, we may not rest complacently on past achievements or even in the present. As the *Field* of London stated recently: "Agriculture is changing so fast that experience of past methods is less useful than knowledge of new ones and the mental adaptability and courage necessary to try them. This alone goes a long way to justify expenditure on agricultural education and research".

A most interesting experience has been the Station's part in several federal relief projects. These have done double duty by speeding up the control of pests and by giving many of the unemployed productive work. At one time we were directing more than 2000 men. The largest group, more than 1000, was on mosquito elimination; about 200 helped in the Gipsy Moth control; Dutch elm disease, European pine shoot moth, and white pine blister rust accounted for the balance.

Field Days and Station Bulletins

Field days and bulletins are two of the means used by the Station to disseminate information. There were four field days in 1934: two at the farm at Mount Carmel and an early and a late vegetable field day at the Substation at Windsor. All of these were well attended, but the annual Station Field Day on August 22 was one of the best the Station has ever held. At the last minute Secretary of Agriculture, Henry A. Wallace, who was to address the meeting, was detained by the death of Speaker Rainey. Nevertheless about 1500 persons, farmers, and men and women representing every walk of life, inspected the exhibits and experimental plots and after lunch gathered in a big tent pitched on the alfalfa field. Director Slate and Governor Wilbur L. Cross, chairman of the Station Board, made short addresses. Then the Director introduced Dr. Mordecai Ezekiel, economic adviser to Secretary Wallace, who had been sent from Washington to represent the Secretary.

Dr. Ezekiel's topic was: The Agricultural New Deal—what it is; how it works and what it is attempting to do; and what it means to New England. His succinct explanation of each part was well received by the audience. In discussing the AAA program, he emphasized the point that the ultimate aim is not to reduce, but to increase, production. Quoting recent statistics, he showed that a good standard of living for everyone would demand such an increase. Meanwhile the AAA believes it is necessary for farmers to curtail their production just as manufacturers reduce their output to meet market demand. He said that New England had already felt the benefits of larger farm income in greater sales of manufactured goods to rural people in the West. Her tobacco farmers have been testing production control with good results, and the milk producers may later adopt a plan.

During the year many members of the staff have addressed groups of growers and of scientists telling about their work on some special problem or the advancement in one line of research. A list of publications for the year is appended to this report.

Noteworthy Station Publications

Among the station bulletins demanding special comment are the *Plant Pest Handbook, Part II, Diseases and Injuries,* by Dr. G. P. Clinton; and *Tobacco Culture in Connecticut* by Dr. P. J. Anderson, in charge of the Tobacco Substation at Windsor. These two books are valuable contributions to the world of science and to the farmer and gardener. Dr. Clinton has been Station Botanist for more than 30 years. His work has been recognized by national groups by his election as fellow of the

National Academy of Sciences and of the American Academy of Arts and Sciences.

The *Plant Pest Handbook* is the summation of his observations and studies over this long period in Connecticut. All diseases of plants that have come to his attention are listed, together with a brief discussion of the symptoms, cause, and, where possible, the control or cure. Together with *Part I, Insects,* published by Dr. W. E. Britton last year, this book forms a cyclopedia of plant pest information for Connecticut.

Dr. Anderson's bulletin is a history as well as a guide to tobacco growing in the State. After a brief review of tobacco culture from Indian days to the present, the author describes in detail the varieties of tobacco planted, the methods of cultivation from preparation of seedbeds to curing, and the insect and disease enemies of tobacco, with controls.

Staff Members Honored

Several members of the staff have been honored by outside organizations in recognition of their scientific contributions. In June, Dr. Donald F. Jones was elected a fellow of the American Academy of Arts and Sciences.

At the request of Governor Cross, the Director has served since December, 1933, as Chairman of the State Planning Board. This has required spending considerable time in Hartford and a number of trips to Boston. However, the possibilities for public service of a peculiar type are almost unlimited and the experience has been very interesting. In accordance with the Governor's wishes, the Planning Board has kept its program to "fact-finding" projects rather than "planning". Because the function of the Station is primarily fact-finding, it would seem that our experience and point of view should be valuable.

SPECIAL INVESTIGATIONS

The Dutch Elm Disease in Connecticut

The departments of botany, forestry and entomology have been particularly concerned with the Dutch elm disease. While this disease is caused by a fungus, *Graphium ulmi,* and is therefore a botanical problem, it is carried from infected to healthy trees by certain beetles and so involves the entomologists. The fact that the fungus attacks one of New England's most valued shade trees makes it a vital concern of the forester also.

The Station Botanist is thoroughly familiar with *Graphium ulmi.* Ever since the outbreak of the disease in the Netherlands fifteen years ago, he has kept in close touch with scientific investigations, and has constantly watched for its possible appearance in Connecticut. Thus, when it was discovered in New York and New Jersey in 1933, the Station was prepared to meet the emergency.

Immediately the Botanist made a preliminary survey of elms in the State. No cases of *Graphium* were found at that time. Later in the autumn of 1933, a single case was located in Glenville, Connecticut, close to Westchester County, New York, where the disease is present.

During the winter, the Federal Government set up an office for Dutch elm disease control at Stamford and the Station coöperated with the activities of this agency. Together they supervised a crew of CWA workers in an intensive scouting campaign of southern Fairfield County. This resulted in the discovery of a second diseased tree.

57 Diseased Trees Found In One Year

After the CWA disbanded in May, a few experienced federal workers continued to scout in the section around Greenwich. Whenever an elm showed visible symptoms of disease — leaves wilting and turning yellow, and brown discoloration in the outer rings and under the bark of a cross-section — specimens were sent to the federal laboratory at Morristown, New Jersey, and to the station laboratory at New Haven. The field symptoms of *Graphium* so closely resemble other elm troubles that diagnosis can be made by laboratory culture only. Before the end of the summer, 56 specimens had been confirmed as *Graphium.* Diseased trees were cut down and burned.

In August and September the Station made a second, more intensive, state-wide survey of elm trees. Every town was visited, with the exception of that part of Fairfield County covered by the federal scouts. Of the many trees examined, 120 appeared to have symptoms of *Graphium* and samples were sent to the station laboratory. One tree only yielded a culture of *Graphium.* Further intensive search failed to locate any other cases in the region and the occurrence of this isolated diseased tree is yet a mystery.

The Botanist reports the significance of this one case: "It was found at Black Hall, Old Lyme, 50 miles from Fairfield County. The bark

contained the fruiting stage of the fungi more abundantly than any other tree in Connecticut to date. The European elm bark beetle, *Scolytus multistriatus,* known carrier of *Graphium,* was not present, nor was this insect found in the vicinity. Instead, the mature beetles and larvae of the native *Hylurgopinus rufipes* were present, as well as mites. These beetles, their larvae and the mites were found to be local carriers over the infested bark, since all of them were able to transfer the *Graphium* to media in Petri dishes."

A New Carrier Found

The adult beetles also proved to be disease carriers. Placed in a test tube with twigs of healthy elm, they immediately bored into the bark. Later a culture from these twigs gave positive evidence of *Graphium.*

More than 50 dead or dying trees reported by the scouts were examined by the botanists. None of them contained *Graphium,* although a saprophytic *Graphium* did appear in some. So far the asco stage of *Graphium ulmi* has not been found in nature in this country. In a few cases the conidial stage has been produced by spraying pure culture of the spores on elm bark in moist chambers.

The scouts also made maps of the roads covered, indicating the condition of elms as good, fair and poor. These will be used in further surveying and scouting next spring. Trees reported to be in poor condition are being watched.

Committee on Elm Disease Formed

In October, interested citizens organized a Connecticut Committee on Dutch Elm Disease and the Station Forester was elected chairman. This local group cooperates with the New England Committee to urge federal action on the disease and to carry on a local educational campaign.

Acting together, New York, New Jersey and Connecticut appealed to the Federal Government to assign an emergency allotment of $500,000 of PWA funds to finance immediate sanitation of infected areas. By sanitation is meant not only destruction of all diseased trees, but of elms, and parts of elms, dying from any cause. These measures carried out during this winter should reduce the number of beetles that hibernate under the bark of weak elms, thus eliminating possible sources of infection.

Governor Cross has taken an active interest. He has given all possible aid and support to both state and federal programs in their fight to save the elms of Connecticut.

A Comparison of the Weather Records at the Station Farm and the Weather Bureau Station in New Haven

The importance of accurate weather records to many fields of human endeavor, especially agriculture, is quite obvious. But in scientific investigations with plants and insects, their great value is often overlooked. The disturbing factor is the local variations that occur, particularly in a region with the location and topographic irregularities that are found in Connecticut. This State is bounded on the south by Long Island Sound and cut through the middle by the Connecticut River. Along the shore of the

sound and in the valley of this river the climate is somewhat milder than throughout the rest of the State. Two localities within a relatively short distance of each other may show considerable differences in weather conditions at any one time. This is particularly evident in temperature, in precipitation, and in wind velocity.

In 1931, we installed a fairly complete set of weather recording instruments on the experimental farm at Mount Carmel, Hamden. Prior to that time, dependence was placed on the records of the Weather Bureau at New Haven. A comparison of the weather records of the last three years, taken at the United States Weather Bureau Station at New Haven and at Mount Carmel, 7.5 miles north of the New Haven weather station and at a somewhat higher elevation, are very enlightening and demonstrate the need for many more weather stations in the State.

The instruments at the weather bureau station at New Haven are about 74 feet above sea level and in the center of the city, about one mile north of the shore of Long Island Sound. The instruments at the station farm are about 220 feet above sea level and 8.5 miles north of the sound. A low range of hills extends from a point about three miles northeast of the farm westward and then southward to terminate at West Rock, six miles south-southwest of the farm. The height of these hills varies from about 300 to 737 feet above sea level, the highest point, the Sleeping Giant or Mount Carmel, being about two miles north and slightly east of the farm. Directly north of the latter, at a distance of about one mile, the elevation is about 300 feet. Low land separates the farm from these hills to the north and west. The natural air drainage from the inland regions toward the sound is checked by this range of hills, and this probably accounts in part for lower winter temperatures which frequently occur on the northern side of the elevation.

In the following table, the mean monthly temperature and the monthly precipitation at Mount Carmel for the years 1932 to 1934 inclusive are compared with those of New Haven for the same years and with the New Haven normal means, based on records over a period from 1873 to date. The mean monthly temperature at Mount Carmel is usually between two and three degrees lower than that of New Haven, except for April and May, when it is between one and two degrees lower. During the winter months, the extremes of low temperature show a greater difference. During the period involved, the temperature at New Haven registered +10 degrees Fahrenheit or lower on 27 different days, whereas at Mount Carmel this occurred on 61 days. On 16 of these days the Mount Carmel temperature went to between 10 degrees and 16 degrees below that of New Haven. This is important in regard to injury to plants by cold and to the mortality of insect pests.

During the hottest days of summer, when the temperature is above 90 degrees Fahrenheit, the instruments at Mount Carmel usually register from one to four degrees above New Haven. The wind direction and velocity probably influence the extent to which the temperature at the two localities vary.

Monthly Temperature and Precipitation at New Haven, Conn., and Mount Carmel, Hamden, Conn., 1932 to 1934 Inclusive

Year	Month	Mean temperature			Total precipitation		
		Mt. Carmel	New Haven	New Haven normal	Mt. Carmel	New Haven	New Haven normal
1932	Jan.	36.7°	39.6°	28.3°	4.95″	5.63″	3.98″
	Feb.	30.6	33.0	29.1	2.50	2.51	4.16
	Mar.	33.6	35.8	35.8	5.35	6.28	4.10
	Apr.	45.6	46.8	47.2	2.83	1.93	3.52
	May	58.0	59.4	57.9	2.00	2.64	3.69
	June	66.1	67.0	66.6	2.12	2.16	3.10
	July	70.7	72.5	71.6	1.77	2.79	4.32
	Aug.	70.4	72.8	70.3	4.40	3.88	4.26
	Sept.	62.8	65.1	63.6	3.65	3.55	3.54
	Oct.	52.9	56.1	53.7	5.28	5.51	3.66
	Nov.	39.1	41.7	42.0	6.72	6.45	3.35
	Dec.	32.7	36.1	32.5	2.43	2.25	4.01
	Total				44.00″	45.58″	45.69″
1933	Jan.	34.2°	37.2°	28.2°	2.12″	1.73″	3.98″
	Feb.	29.6	32.4	29.0	5.00	4.15	4.00
	Mar.	34.7	36.7	35.8	6.30	6.60	4.10
	Apr.	46.1	47.4	47.2	4.98	4.64	3.52
	May	59.7	61.4	57.9	2.55	2.00	3.69
	June	67.2	69.2	66.6	2.70	2.26	3.10
	July	69.5	72.4	71.8	3.17	3.58	4.32
	Aug.	69.2	66.8	70.3	6.70	7.39	4.32
	Sept.	64.1	66.6	63.5	5.66	5.05	3.54
	Oct.	50.3	53.6	53.8	3.10	2.64	3.66
	Nov.	37.1	39.4	42.0	.77	.90	3.35
	Dec.	26.0	29.2	32.5	3.54	4.51	4.01
	Total				46.59″	45.75″	45.59″
1934	Jan.	29.3°	31.6°	28.2°	4.02″	3.52″	3.98″
	Feb.	14.0	17.4	29.0	3.39	3.82	4.00
	Mar.	32.5	35.4	35.8	3.18	4.68	4.10
	Apr.	47.2	48.4	47.2	7.82	4.98	3.52
	May	59.2	60.4	57.9	6.66	5.23	3.69
	June	68.2	70.0	66.6	4.56	3.42	3.10
	July	72.3	74.8	71.8	2.34	3.04	4.32
	Aug.	65.7	68.6	70.3	2.19	2.45	4.26
	Sept.	64.8	66.5	63.5	11.07	8.76	3.54
	Oct.	48.8	51.6	53.8	2.72	2.51	3.66
	Nov.	44.2	46.7	42.0	4.35	3.28	3.35
	Dec.	28.7	31.2	32.5	4.99	3.34	4.01
	Total				57.29″	49.03″	45.53″

In estimating the mean temperatures, the procedure differs at the two stations. Daily means are determined by averaging bi-hourly temperatures at Mount Carmel, and the monthly mean is the average of the daily means.

At New Haven the daily mean is half the sum of the maximum plus the minimum, and the monthly mean is half the sum of the monthly mean maximum plus minimum. The difference in the result obtained, however, is rarely as much as one degree. In 1933, for example, the difference was over one-half of one degree for one month only.

That marked differences in precipitation can occur between two such closely adjacent localities in Connecticut is indicated in the tables, particularly in the data for 1934. During six separate months of the year the Mount Carmel Station showed more than an inch of rainfall in excess of that shown in New Haven, and in two of those months the excess was over two inches. Nor is this the whole story. Local summer rains are of common occurrence in the State and may be limited in extent. For example, from the eleventh to the fourteenth of June, 1934, rainfall occurred every day at Mount Carmel and the total for the four days was 1.81 inches. At New Haven it rained on the twelfth only and .59 inches were recorded. On July 8 of the same year, .52 inches of rain fell at Mount Carmel and .10 at New Haven. On July 28, .53 inches fell at Mount Carmel and 1.03 inches at New Haven.

The total wind movement at New Haven during the three years was considerably in excess of that at Mount Carmel. The data are: for 1932, 82,847 and 64,381 miles; for 1933, 82,495 and 63,153 miles; for 1934, 79,181 and 56,047 miles, respectively. This same relative difference holds throughout the months of the year.

There follows an account of the work of the several departments, dealing especially with items of particular interest and importance. A complete list of projects will be found on page 95.

Progress of the Station's Work

ANALYTICAL CHEMISTRY

Fertilizers Analyzed

One of the important services carried on by the department of Analytical Chemistry is the registration and analysis of fertilizers sold in Connecticut. The results of the inspection are given in Bulletin 365.

The past year, 1934, marks the smallest number of samples analyzed in the ten year period beginning in 1925. During this decade the peak of registrations was reached in 1930 with 439 brands. In the same year the largest number of samples were examined in the laboratory. This is the natural reflection of conditions throughout the country. According to data compiled by the National Fertilizer Association, the peak of fertilizer consumption in the United States, a little more than 8,000,000 tons, was reached in 1930. It fell off nearly one-half in the next two years but is now on the increase.

In the past ten years, there has been a marked improvement in the proportion of samples meeting their guaranties. In 1923, only 55 per cent of those examined met guaranties in all respects. Since 1928, the proportion has not been less than 70 per cent; in 1930 it was 80 per cent; and during the past year it was 79 per cent.

Since 1929, commercial deficiencies exceeding $1.00 per ton were found in not more than 3 per cent of the samples of mixed fertilizers examined. During the past year this percentage was 2.3.

Two instances of ground bone adulterated with rock phosphate were found.

More Feed Samples Meet Guaranties

During 1933, 1299 samples of feeds were analyzed and the annual report of inspection was issued as Bulletin 362 in April, 1934. Of these, 815 were official samples of commercial feeding stuffs collected by the Station Agent; 385 were samples of experimental plant materials examined for the Storrs Station; and the remainder were miscellaneous feeds examined for purchasers. The proportion of samples meeting guaranties has increased noticeably in the last three years. The proportion meeting individual guaranties has been high since the present statute concerning feeding stuffs control was enacted in 1925, but especially so since 1930.

A summary of deficiencies found on analysis of official samples, given below, is self-explanatory.

Year	No. of official samples	Samples meeting guaranties %	Individual guaranties met %
1925	488	83	94
1926-27	670	83	94
1928	716	78	92
1929	646	82	94
1930	678	81	93
1931	739	88	96
1932	836	85	95
1933	815	88	96

17% Food and Drug Samples Below Par

Examination of 1,528 samples of foods and drugs in 1933 revealed that 17 per cent fell below standard, were adulterated or otherwise illegal. This work is summarized in Bulletin 363 and was done for purposes of food and drug control in the State. Malt beverages, vegetable food oils, ice cream and spray residue on fruits and vegetables were the items of foods given most attention. No significant excesses of lead or of arsenic were found on any of the market samples examined. Drug inspection included 24 official preparations, listed in the United States Pharmacopoeia and National Formulary, of which about 250 samples were taken at drug stores throughout the State. Variations from standard quality were noted chiefly in chlorinated soda, compound solution of iodine and solution of magnesium citrate. Eight samples of whiskey labelled as medicinal grade did not meet the specifications for that article as judged by U.S.P. standards.

More than 2,000 pieces of glassware used in testing milk and cream by the Babcock test were checked and certified as to accuracy.

Members of the staff of the department of analytical chemistry have collaborated in studies of analytical methods sponsored by the Association of Official Agricultural Chemists. Dr. Fisher has investigated methods for the determination of calcium gluconate. Dr. Bailey has continued to serve on the Council for Foods of the American Medical Association.

BIOCHEMISTRY

Chemistry of the Tobacco Plant

The chemical investigations of the tobacco plant carried on by the department of Biochemistry this year have included a detailed study of the rate of growth of shade-grown tobacco from the seedling to an advanced stage of maturity. Collections were made at frequent intervals throughout the season and the leaves, stems, and fruit have been analyzed chemically in considerable detail. The data obtained permit us to follow the accumulation of various organic and inorganic constituents in the plant as growth progresses; particular attention has been paid to the different forms of nitrogen and to the organic acids.

An important outcome of this work has been the study of the amide nitrogen of the tobacco plant. At least two different amides are present in tobacco, one of which is definitely known to be asparagine. There is much evidence that glutamine is also present and there are indications of still a third type of amide nitrogen.

Protein Chemistry

The investigation of amides has naturally led to a detailed study of the extremely rare amide, glutamine. This substance has been found in the leaf and stem tissue of the tomato plant and is especially plentiful in beet roots. A method developed in the laboratory this year makes it possible to obtain considerable quantities of glutamine from this source in pure form. A study has also been made of the effect of liberal fertilization with ammonium sulfate upon the glutamine content of beet roots.

The studies of protein composition have included a new determination of the basic amino acids of casein and of the cystine content of the hemoglobins of the horse, sheep, and dog. The mercuric chloride complex compounds of several amino acids have been investigated with the object of developing new methods of separation of amino acids by the use of mercury reagents.

Nutrition Investigations

One of the current trends of interest in nutrition is concerned with the part played by the inorganic salts in the diet. For several years the department has carried out an elaborate series of experiments to determine the mineral requirements of the albino rat. Four of the artificial salt mixtures widely used in experimental diets employed in nutrition studies have been compared at various percentage levels in otherwise adequate rations. On the basis of rate of growth (from 60 to 200 grams body weight, as well as of percentage of bone ash) the different salt mixtures showed definite variations in efficiency, particularly at the lower levels.

Following these observations, the various salt mixtures were supplemented with pure salts. By this device it was found wherein the inferiority of the salt mixtures lay and also the reason for the superiority of the better salts. Among other things, this experiment again emphasized the significance of an adequate level of calcium in the diet of the albino rat.

With the foregoing experience available, it then became possible to formulate a new salt mixture combining the desirable features of the various mixtures now used. This extensive investigation, carried out with meticulous attention to experimental details, is another of the fundamental contributions of this laboratory to the basic nutrition of the extraordinarily useful albino rat.

Mating and Productivity of Rats

The investigation of the reproduction of the albino rat on a presumably complete diet has been continued in our laboratory for a period of four years under the supervision of Professors Arthur H. Smith and William E. Anderson of Yale University. Breeding experiments with the first four generations have been concluded.

In regard to the relationship of the interval between matings and reproduction performance, the supplementary information obtained during the past year indicates that the longer period of rest results in greater reproductive success. Whereas in the fourth generation 91 per cent of the matings were fertile in the group with three weeks of rest between periods of reproduction, only 78 per cent of the matings were fertile in the group permitted to rest but one week. Furthermore, in the former group, 80 per cent of the young were successfully weaned, whereas, in the second group, only 61 per cent of the young were weaned.

In last year's report attention was called to the high average level of body weight of young at weaning in all groups in the first three generations. A comparison at the present time of similar values in the fourth generation —based on observations of approximately 1200 animals—indicates an unmistakable trend toward lower weaning weights in all groups. These additional data emphasize the importance of carefully controlled breeding experiments extending over relatively long periods.

Further investigation of vitamin concentrates has been made. As a new feature of this work, a study has been undertaken of the rate of growth of the offspring of rats daily injected with an extract of the thymus glands of calves.

The investigations in this laboratory are supported, in part, by the Carnegie Institution of Washington.

BOTANY

Chestnut Blight Makes Less Progress

The chestnut blight (*Endothia parasitica*) seems to have made less deadly progress on seedlings in 1934. Each year for the past eight seasons, the Station Botanist with the coöperation of the Forester has planted nuts from southwestern Virginia at the Station and seedlings have been set out in selected places at Fairfield, Orange, Rainbow and Portland. A bushel of chestnuts was planted last autumn and next spring about 1,000 one-year seedlings will be ready for transplanting.

The purpose is to watch the progress of the blight; to determine, if possible, whether it is less prevalent, or whether the disease becomes less virulent, as time goes by. In the last few years more of the young trees have been killed by drought than by blight, the Botanist reports. Nevertheless the blight seems to attack them when they reach a certain size. The largest saplings are about 25 feet tall with a four-inch stem.

The past season was favorable to chestnut growth. There were many finds of burrs on sprouts from old stumps and on seedlings, and the trees increased in size because moisture conditions were better. This was especially true at Orange and Rainbow where fertilizer was applied last spring.

The chestnut tree at Lebanon, more than fifty years old and the oldest known chestnut in the State, is still alive although badly affected. The Botanist reports that it bore a number of burrs and leaves this summer and will probably survive for a year or two longer.

"X" Disease of Peach Trees

The strange trouble that appeared prominently in Connecticut peach orchards in 1932 has been receiving even more of the attention of station botanists this year. So far the exact cause has not been determined and we have called it the "X" disease.

The trouble is characterized by a premature yellowing and ripening of the foliage on all or part of the branches at midseason or later. Sections of the leaf tissue seem to be cut off from the rest of the leaf and fall out, until the foliage presents a ragged appearance. Both fruit and leaves on injured branches, with the exception of tip leaves, drop early, but the new buds on the branch develop normally, showing no symptoms of disease until the latter part of the following June. The peaches that remain on the tree seem to be normal but perhaps ripen a little early.

In the wood of injured branches there is a characteristic brown streaking, extending longitudinally through the branch, and frequently arising from a cut end of a limb, or a cut-off side branch. These symptoms were

obscured during the past summer because much of the wood of peach trees was blackened as a result of last winter's severe cold. In winter, the twig and bud growth on affected branches appear normal and it is very difficult to distinguish healthy from injured trees by external symptoms. Therefore most of the work on the peach trouble must be done in warm weather.

The Station has made investigations of the peach trouble along three lines. There were careful observations and studies in the field to find the distribution, rate of spread, extent of injury and possible control. Attempts were made to discover the nature and cause of the trouble through examination of specimens in the laboratory, budding experiments and chemical analyses. The Soils Department analyzed samples of soils from orchards scouted by the botanists, as well as from other typical orchards, to see if there was any relation between soil conditions and the trouble. Results of some of these studies are now available as recorded below:

Of the 70 peach orchards surveyed by the Botany Department in 1934, affected trees were found in 29, all of them north of Southington. The disease appeared in old and new orchards alike, and in trees planted on soil just converted to orchard use as well as in old soil. Nine orchards mapped in 1933 were checked and eight new orchards mapped. Using these maps, several growers are cutting out diseased trees this winter. In old orchards checked, it was found that the "X" disease increased from 5 to 10 per cent during the year.

In an effort to see whether the disease could be controlled by surgery, last spring unhealthy branches were cut from 41 two-year old trees and the wounds sealed with grafting wax. Of these, 44 per cent appeared sound at the end of the season, but the disease recurred in 56 per cent of the cases. Data will be taken on older trees next year.

Hundreds of specimens of diseased trees were examined in the laboratory in attempts to discover the nature and cause of the peach trouble. Cultures of several fungi were obtained from the wood and these were used to inoculate healthy peach trees to determine whether or not they would reproduce the disease. One fungus, most commonly found, produced definite streaks extending from one to six inches beyond the point of inoculation and the fungus inoculated was recovered. However, no conclusions can be reported without further research.

In 1933, budding experiments were made to see whether the trouble was caused by a virus. Buds from diseased branches were grafted into 96 healthy seedlings. Of these, 43 buds took and only three showed leaf symptoms of the peach trouble. In general, if a bud affected by a virus disease is grafted into a healthy tree, it will give the disease to the tree whether the bud grows or not. Indications are, therefore, that "X" is not a virus disease.

The Soils Department found no relation between the peach trouble and prevalent condition of soils in the peach orchards of Connecticut. The findings are given later in this report.

Although actual cause and control of the "X" disease are still a mystery, in general it seems advisable to remove affected trees from peach orchards as a precaution against spread.

Bordeaux Doubles Potato Crop

The yield of potatoes may be doubled by the proper use of Bordeaux mixture, according to results obtained for four successive years at the station farm at Mount Carmel. The same experiments prove that 8-8-50 Bordeaux gives better crops than the 4-4-50 mixture. Tests this year indicate further that the amount of spray is more important than the pressure in obtaining necessary coverage of foliage.

Controlling Late Blight of Tomatoes

Bordeaux mixture and red-copper-oxide sprays have been found the most effective of materials tested in checking late blight on tomatoes. Early and thorough spraying before the blight started kept the plants free from blight for several weeks. Later applications of Bordeaux or any other materials did not check the blight once it was established. Red-copper-oxide not only was very satisfactory in control of late blight but it caused no discoloration of the tomato fruit.

Greenhouse experiments showed that the same disease, *Phytophthora infestans,* attacks potatoes as well as tomatoes. Search of the old infected parts of both hosts failed to show any sign that oöspores were developed. However, it was concluded that not only the tubers of the potato carry the mycelium but that the seeds of the tomato can also carry them, in some cases over the winter. Just what happens later with this mycelium is not known, but first infections this year and last were seen on the leaves in contact with the ground.

In 1934 the blight got an early start at Guilford, making its first appearance about the middle of August. Closely watched plots in Hamden did not show the first evidence until September. Mulching the plants or staking them off the ground failed to prevent the fungus appearing on either potatoes or tomatoes. In fact, the two plots so treated at Hamden became as quickly and as badly infected as those plots where plants lopped over the ground. Thorough spraying with Bordeaux mixture, on both plants and the ground, was very successful, and, to a less extent, frequent dusting paid.

Studies of Vegetable Diseases

The Botany Department has carried out further experiments in the control of downy mildew of cucurbits, Stewart's bacterial wilt of corn, and club-root of cabbage and cauliflower. Studies have been made of a mosaic disease of rutabagas and of an undetermined trouble of carrots.

In the greenhouse, experiments have been conducted for the control of damping-off of vegetables and other seedlings. Comparative tests have been made of various seed and soil treatments for the control of pre-emergence and post-emergence damping off, together with culture of seedlings in pure sand to which nutrient solution has been added. More seedlings survived through the sand culture method than through other treatments in soil.

Bacterial Wilt of Corn Less Troublesome

While bacterial wilt on corn (Stewart's disease) was a serious menace to the crops for the past two seasons, this year there was very little disease in the State. A member of the United States Department of Agriculture working in New England claims that the severe winter reduced infection. Either the insect carrier may have been killed off, or the bacteria may

have been destroyed in the ground. At any rate, little disease appeared on either the most susceptible (Golden Gem) or the most resistant (Golden Cross Bantam) varieties of corn. However, the Bantam showed greater resistance to smut.

Disease Survey Continues

While the *Plant Pest Handbook* covers plant troubles studied by the Station Botanist for 32 years in Connecticut, the disease survey continues for the purpose of bringing information up-to-date yearly, and reporting new diseases and injuries, or old troubles attacking new hosts. Two new troubles were listed during the past year. The most important of these is a nematode injury caused by *Aphelenchoides fragariae* on chrysanthemums, found in a nursery at Bristol. It was especially bad on the variety "Mercury". The other trouble is the less injurious fungus of sweet potato caused by *Monilochaetes infuscans*.

Losses Result From Severe Cold

The severe winter of 1933-34 injured or killed a great variety of less hardy shrubs and trees, especially privet, roses, peaches and certain varieties of apple. The moist weather of early spring and fall was rather favorable to fungous troubles. The black spot of elm (*Gnomonia ulmea*), rust of apples (*Roestelia pyrata*), and late blight of tomato, and to a much less extent, of potatoes (*Phytophthora infestans*) were the most important.

Seed Testing Service

As in other years, there were direct services to farmers. Whenever growers reported vegetable crop troubles, examination and diagnosis were made and advice on control methods offered when possible. In accordance with the seed law, 156 samples of seeds were collected and analyzed and a report made to the Commissioner of Agriculture. In addition, analyses were made of 247 samples submitted by individuals, and of 91 straight seeds and 65 lawn mixtures.

Radio Spray and Weather Reports

A daily radio spray service and weather report was conducted over three radio stations from May 1 to June 15. This service, maintained in coöperation with the Connecticut State College Extension Service, gave timely information on spraying with special reference to control of apple scab, basing the recommendations on the discharge of ascospores as determined by examination of material collected in various sections of the State.

ENTOMOLOGY

Control of Oriental Fruit Moth

The search for sprays and parasites to control the Oriental fruit moth has continued actively at the Station. This is the most destructive insect pest of peach and quince in Connecticut. Sprays of derris and lead arsenate used on quinces produced a crop freer from infestation than in any previous year. In an experiment aiming to prevent moths from laying eggs on trees, one tree

was covered with tobacco cotton cloth about the first of August. Apparently the results were good.

As in previous years, parasites of the Oriental fruit moth were reared in the entomological laboratory and distributed for release in orchards. This is a coöperative program initiated and sponsored by the Connecticut Pomological Society. By a new arrangement started in 1934, the society takes responsibility for assembling the orders for Trichogramma parasites and collects the charge made. As peach fruit buds were all killed by the low temperatures of the winter, many growers did not think it necessary to obtain parasites. This, together with the charge, although this was very low, doubtless explains the smaller demand—10,000,000 in 1934 as against 28,300,000 in 1933.

However, the distribution of Macrocentrus parasites increased sixfold. A new method for rearing these, devised at the Station, made it possible to send out 24,000 in 1934 as against 4,600 in 1933. In addition 4,700 other parasites were reared and liberated in Connecticut peach orchards. These and the Macrocentrus are still on an experimental basis and are distributed without charge.

The Federal Bureau of Entomology and Plant Quarantine has supplied some new species of parasites from the Orient, and the staff is studying their characteristics and life habits. Some of these will be ready to send out next year. It is believed that they offer considerable promise in the control of the Oriental fruit moth in Connecticut.

Substitutes for Lead Arsenate

Experiments with substitutes for lead arsenate continue to interest both the farmer and the housewife. In recent years growers of fruits and vegetables have been confronted by a double problem: The grower must protect his crops from insect or disease injury; the consuming public is increasingly conscious of the danger in residues from poison sprays and dusts used as control measures. The Secretary of Agriculture has set limits, or tolerances, on the amount of poison permitted on foods sold interstate.

Lead arsenate is the poison most commonly employed. Both lead and arsenic are poisonous to man if taken in large enough quantities. Of the two, lead is now considered more dangerous because of its cumulative effect. In 1934, the heavy autumn rains in Connecticut washed most residue from fresh food products. Of the samples examined in the analytical laboratory, very few contained poisons above tolerance and only one of these had been offered for sale. The rest were submitted by growers anxious to know the results from certain sprays.

Experiments with substitutes at the Station followed two lines: (1) to protect foliage from arsenic burn resulting from decomposition of calcium arsenate; (2) continued experiments with cryolite, the most promising of the non-arsenicals tested last year. It was apparent that improvement in the standardization of physical properties of synthetic cryolite is greatly needed. One of the most striking characteristics is its poor adherence to the fruit. The lot used was ineffective in controlling curculio and codling moth but showed promise in control of the apple maggot.

Attempt to Control Onion Thrips

In experiments to control onion thrips, 40 pounds of finely ground, crude, chipped naphthalene were mixed with 60 pounds of hydrated lime and dusted on onion plants at the rate of about 125 pounds to the acre. The first application seemed to reduce the thrips population about 50 per cent, but later the plants were just as badly infested as the checks. The plants also suffered some injury from the treatment. These experiments will be expanded and continued.

Corn Borer Problem Increases

The European corn borer is causing heavy losses to farmers and control presents a serious problem. Search for suitable parasites and sprays is going on constantly and offers considerable hope. The "clean-up" is still our main reliance. However, to be effective it must be thorough. To obtain this without the whole-hearted coöperation of entire communities is humanly impossible.

The wet spring weather in 1934 postponed plowing of some fields until after April 10, the time limit set for clean-up of fields in the Statute. Inspectors began work in the four southern counties of the State on April 18 and continued northward. Even at that late date, time extensions had to be granted because of wet land. More careful check was made on cornfields than ever before and it was necessary to report 20 cases to the public prosecutors.

Heavy damage by the first generation corn borers in early sweet corn occurred in the truck crop areas near Hartford, New Haven, and at certain points in New London, Windham and Litchfield counties. There was an estimated loss of $17,843 on 179 farms surveyed. The average loss per acre in sweet corn on these farms was $48.61.

Late in the season it became evident that weed infestation has an important bearing on clean-up work, and a survey was undertaken, particularly in East Hartford. In certain upland areas, the weeds in the corn fields contained as many as 214,573 borers per acre, and on wasteland adjoining the corn fields, the borer population per acre in the weeds was 83,440. On the river meadows, corn stalks had 219,030; weeds in the fields, 106,480; and weeds adjoining the fields, 38,720 borers per acre. The weeds were mostly smart weed, pig weed and lamb's quarters. Giant ragweed on waste areas near the river contained 24,200 borers per acre.

Mexican Bean Beetle Studies Completed

The Mexican bean beetle has been a subject for active research for a number of years. The project was completed last summer and conclusions are now being prepared for publication. This insect, a lady beetle, broadly oval, pale brown in color and with spotted wing covers, is the most destructive pest of beans in Connecticut. During the past year control experiments included the effect of spacing plants, of using non-poisonous insecticides to avoid poison residue, and of comparing sprays with dusts.

Bountiful string beans were planted with 2, 4, 6, and 8 inch spacing between them in the row. Results bore out findings in previous tests. In the 2-inch spacing, there is the largest yield of pods but the largest

percentage of these is injured. The best all-round spacing was found to be 4 inches.

Insecticide experiments on Bountiful string beans showed that satisfactory results can be obtained with non-poisonous materials. Thus 25 and 50 per cent pyrethrum dusts, and .4 and .6 per cent rotenone dusts, all gave larger yields and a larger percentage of uninjured pods than magnesium arsenate spray, and an equally large percentage of marketable pods. Both pyrethrum and rotenone dusts gave good control of leafhoppers as well as of bean beetles.

Fordhook dwarf lima beans were treated with copper-calcium arsenate dust, and with Bordeaux mixture spray, in comparison with check, or untreated plots. Both treatments increased the yield about equally over that of the untreated checks but plants treated with copper-calcium arsenate dust showed the least injury from Mexican bean beetle.

	Check	Copper-Calcium Arsenate Dust	Bordeaux Mixture Spray
Yields, ounces per plant	12.1	15.1	15

More Termite Infestations Investigated

An increasing number of eastern subterranean termites, common in stumps and logs in Connecticut woodlands for many years, seem to be infesting houses of the State. In the past spring and summer entomologists examined 46 houses and found the insects in 39 of them. There were only seven similar cases reported in 1932 and thirteen in 1933.

Termites are common in tropical climates where they destroy property by hollowing out beams, woodwork and even furniture. In this part of the country the injury is not so extensive, but it may be serious and cause considerable damage and expense.

Estimated cost of repairs and termite-resistant construction to 24 of the houses examined was placed at $6,910. The amount of money actually spent was $3,340, since owners preferred to take care of present infestations without making other parts of their premises termite-proof.

In general, termites enter houses through direct contact between soil and wood. They may find cracks in concrete foundations and brick work, however, and sometimes build runways for themselves over a stone surface if the distance between soil and wood is not too wide. They cannot exist without wood and moisture and the workers die when exposed to the sun and air.

Of the houses examined, 15 entries were made through direct contact between wood and soil. In 11 other places, termites had found cracks in the foundation work through which they could enter wood. A complete review of findings and recommendations will be given in the report of the State Entomologist next spring.

Mothproofing Materials Tested

Moths and moth injuries constitute a perennial problem of the home maker. Experiments with mothproofing materials were continued in 1934, and the results will be published in the Entomologist's report.

The Potato Flea Beetle

The flea beetle causes greater injury to potatoes than is generally appreciated. Comparative treatments on potatoes with sprays and dusts for its control this year yielded significant results. A large series of plots of Irish Cobblers was (1) sprayed with Bordeaux mixture plus lead arsenate-fish oil, (2) dusted with barium fluosilicate dust, and (3) left untreated as checks. Four applications were made. The lead arsenate-fish oil plots gave the highest yield, averaging 225 bushels an acre. Bordeaux mixture brought the second largest crop, 217 bushels, and the untreated rows, 149. Thus the highest yield was more than 50 per cent larger than the check. Moreover, lead arsenate and fish oil was the cheapest treatment.

About 25 plots of Green Mountain potatoes were included in a similar experiment comparing (1) 6–6–50 Bordeaux mixture plus 1 1/2 pounds of calcium arsenate, eight applications; (2) barium fluosilicate dust (1-3), two applications, followed by 6–6–50 Bordeaux mixture, seven applications; (3) barium fluosilicate dust (1-3), six applications; and (4) 6–6–50 Bordeaux mixture, eight applications. The highest yield, at the rate of 567 bushels per acre, was from plots treated with (2), the combination of Bordeaux and barium fluosilicate. However, this is the most expensive treatment. Straight Bordeaux (4) came second with 538 bushels; Bordeaux with calcium arsenate (1) was third with 463 bushels; barium fluosilicate dust (3) the cheapest application, yielded only 272 bushels; and untreated plots, 261.

Relief Funds Push Mosquito Elimination

The past year has seen tremendous advances in mosquito elimination work throughout Connecticut. Over a period of 29 years, 1904 to 1933, 11,000 of the 20,000 acres of salt marsh breeding places in the State had been ditched and approved for state maintenance. The ditching of the remaining 9,000 acres was nearly completed in 1934. Small areas are still unfinished in Milford, North Haven and Old Saybrook, and a larger tract in Stratford may require another season for completion. But it is estimated that the work as a whole has been pushed forward by about 15 years.

These important extensions were made possible by coöperation among the local, state and federal offices. All initial ditching in the past was done at local expense. When an area had been properly treated, the Director of the Station accepted it for state maintenance and yearly the State appropriated a small sum for upkeep. Unfortunately communities were not mosquito-proof by virtue of cleaning up their own marshes. Too frequently pests breeding in adjacent unditched territory flew, or were blown by the wind, across the border. It became evident that all marshes had to be drained if the work was to be effective. Under the circumstances progress was slow.

The bright aspect of the program in 1934 was the availability of relief funds for mosquito projects. During January, more than 1000 men were assigned from the lists of the local unemployed and were paid by CWA or state relief funds. Boots, tools and any materials necessary were supplied by the individual towns. The number of workers had been reduced to about 500 in October.

Altogether 1,476,756 feet (280 miles) of ditches have been installed and 259,825 feet (49 miles) of stream banks cleaned. Many improvements in the way of new tide gates, dikes and outlets have been made. The total federal funds expended on wages for the unemployed until October 1, 1934, amounted to $287,299.22, and state and town contributions, $34,729.06.

A larger maintenance appropriation by the General Assembly will be necessary before the newly ditched area can be accepted for state maintenance.

"Fresh water" mosquito projects have been carried on in the five inland towns of Ansonia, Derby, Manchester, New Canaan and Southington, and also in several shore towns.

Investigations of Oil Sprays

Work with oil sprays consisted of tests of tar distillates and cresylic acid combined with commercial spray oils. However, absence of rosy aphids this year prevented collection of good comparative data. Tests were also made with tank-mixed white oils for control of pear psylla and European red mite. For the European red mite a very satisfactory summer oil preparation was made using 1 gallon industrial white oil (80 viscosity) and 1 pound powdered skim milk in each 100 gallons of spray. The combination was quite effective on the red mite. Unfortunately, it killed some other insects that prey on the red mite itself.

Control of White Apple Leafhopper

White apple leafhoppers appeared in some numbers towards the latter part of the season and a series of sprays were tried, using nicotine sulfate with and without soap, and two pyrethrum preparations. Anabasine sulfate gave the best results this year. The use of soap apparently did not increase the kill beyond that obtained with the water solution.

Inspection of Nurseries and Orchards

As usual, members of the department of entomology have inspected all of the commercial nurseries in the State and more than 20 orchards. Again there is an increase in the number of nurseries, the total reaching 376. Last year 365 were listed.

All nurseries that had important pests to be eradicated as found by the first inspection were re-inspected before certificates were issued. A further check, late in the autumn, was made on those growing pine trees to see that the European pine shoot moth had been eliminated. The presence of this insect cannot always be detected if inspection is done in July and August. On the whole it was less prevalent than in 1933, because of the severe winter and the clipping off and burning of infested shoots the previous year.

Gipsy Moth Control

The Station coöperates with the United States Department of Agriculture in combatting the gipsy moth. In general, federal crews work west of the Connecticut River, and state crews to the east. The state forces had made good progress when, beginning November 15, they were asked to supervise 340 CWA men in a state project for the protection of forests under the State Forester.

After the CWA men had been trained, they were organized into scouting crews, each with one of the experienced scouts as foreman. Although the territory assigned had not been covered, all CWA work was discontinued on February 15 and the regular scouts resumed their usual scouting duties. The CWA crews made possible the discovery of rather large infestations, mostly in forest areas, in 21 towns. Some of these infestations were later cleaned up and sprayed by station crews. Altogether, east of the Connecticut River, 11 towns were completely scouted, 28 were partially scouted, and in 20 no work was done.

State and federal forces together worked in 107 Connecticut towns, found 453 infestations, creosoted 434,410 egg-clusters, sprayed 47 separate infestations, besides 2,371 acres of woodland, and 2,861 street trees. Scouts covered 4,252 miles of roadside and 435,581 acres of woodland.

Valuable assistance was rendered by men in the CCC camps. Here the work was well organized under the direction of the camp superintendents. They scouted an additional 13,828 acres of woodland.

Inspection of Apiaries

Of the 1,420 apiaries inspected by entomologists, only 27 were infested with American foul brood and two with European foul brood in the past year. There were 7,128 colonies included in these hives.

Sprays and Dusts Compared

The object of the spraying and dusting experiments, carried on coöperatively by members of the departments of botany and entomology, is to find the most economical materials that will give best control of pests and also overcome spray injury. This year the following combinations were used on trees in the west apple orchard at the station farm at Mount Carmel: (1) a combination of lead arsenate, lime and fish oil, with no fungicide; (2) dry lime-sulfur and lead arsenate; (3) flotation sulfur and lead arsenate; (4) magnetic sulfur and lead arsenate. Several trees were left untreated as checks. Based on previous experience in these orchards, the spraying schedules were arranged to give the maximum control with the minimum number of sprays. As in previous years, lead arsenate lime-fish oil gave good control of fungi on all varieties of apples except scab on McIntosh. The tabulated results for the various treatments follow:

Average On All Varieties

	Check	Lead arsenate, lime and fish oil	Dry lime-sulfur, lead arsenate	Flotation sulfur, lead arsenate	Magnetic sulfur, lead arsenate
Good	1.43	65.2	71.69	68.86	69.79
Curculio	74.99	31.4	25.1	5.75	26.36
Codling Moth	15.23	.13	.14	....	.61
Other chewing insects	40.04	1.91	2.70	1.60	.78
Scab	11.37	1.37	.71	.47	3.67
Rust	....	....	....	24.43	....
Blotch	38.11	.68	....	....	....

The Insect Survey

Collections and observations of Connecticut insects went on as usual and reports were sent each month to the Insect Pest Survey Bulletin. Many specimens are brought or sent to the Station annually for identification. Members of the department are on continual watch for specimens not included in the

extensive station collection and for insects appearing in Connecticut for the first time. They classify and mount these, keeping records of the date and place of appearance, and the hosts. They also find out from records of other states and countries what harm the insect is capable of doing and possible methods of control. Last year the following new insects appeared in the State for the first time: The beech scale in Hartford; the Dermestid beetle in Bridgeport; and the holly leaf miner in Hartford and Newington.

FORESTRY

Blister Rust Control Extended

Four projects employing an average of 370 men throughout the year made up the enlarged program for control of white pine blister rust in Connecticut in 1934. This work was directed by the Forestry Department in coöperation with the United States Department of Agriculture and was financed chiefly by the Federal Government through the CCC, CWA, ERA, and NRA.

Blister rust has been a deadly foe of white pines for many years. Thanks to eradication measures, the prospects for control in this area are now good. It is a fungous disease depending on currant or gooseberry bushes, *Ribes,* as alternate hosts to propagate the spores. It does not spread from pine to pine, but from pine to *Ribes,* and thence to healthy pine. Blister rust has threatened a valuable state resource.

This year workers were engaged in the following ways:

They removed more than 860,000 wild Ribes from 73,000 acres of land. These bushes grew within infecting distance, 900 feet, of white pine stands. As a result, trees in 26 towns were protected from the rust.

They made a survey of 66 towns locating 5,500 patches of cultivated Ribes within the danger zone. All black currant bushes, outlawed in this and some other states, were removed, and nearly 20,000 other varieties were destroyed.

Two new nursery sanitation zones were established and nine existing zones re-checked, with the removal of 2,150 wild, and 51 cultivated, Ribes from 3,685 acres.

Maps showing pine stands were made in 15 towns in the northern part of the State. As a result, the efficiency of future control work in these towns should be greatly increased.

The White Pine Weevil

Another enemy of the white pine is the weevil that attacks leaders and causes distortion of the trunk, thus spoiling its timber value. Local control undertaken last year was continued from the middle of June to the early part of August by crews from nine CCC camps. More than 5,000 acres in 21 towns were covered and approximately 128,000 infested leaders removed. A comparison with last season's work shows the infestation to have decreased throughout the 10 areas covered. In one section of 150 acres, the infestation was almost 50 per cent less than the previous season. It is anticipated that work may be continued for another year,

and that better information will be secured regarding the possibility of controlling this forest pest.

Measuring Pine Weevil Damage

A second project in connection with the white pine weevil was carried on by the department of entomology, acting in coöperation with the United States Bureau of Entomology and Plant Quarantine. In this, measurements of the degree of trunk distortion in weeviled white pines of various ages and rates of growth are being made. The purpose is to develop a method of predicting the amount of recovery that will occur in weeviled trees before the crop is cut.

Pine Shoot Moth Infestation Reduced

Control measures and the severe cold of last winter seem to have reduced the European pine shoot moth to the lowest point in three years. The larva infests the tips of red, Scotch and some other pines, retarding growth. Repeated attacks may kill the trees. Between September, 1933, and July, 1934, crews from the CCC camps and CWA workers carried out control measures directed by the departments of forestry and entomology. Nearly 800 plantations comprising 11,000 acres in 125 towns were covered, and millions of infested shoots were cut off and burned. Spring measures were most effective since they followed the killing cold of the 1934 winter. It is estimated that between 80 and 90 per cent of the larvae in the shoots perished. Plans for the coming season include thorough scouting during the winter with men furnished by the ERA, followed by a vigorous program during the spring of 1935 with CCC crews. The entomologists are making a survey of all red pine plantations, and further biological data, particularly regarding parasites and predators, must be gathered next year.

Durability of Treated Posts Tested

Since the disappearance of the chestnut from the hillsides of Connecticut, farmers have been hard pressed to find durable wood for posts. Experiments conducted by the Forestry Department have shown that other native woods properly treated with creosote may equal or even surpass the chestnut in durability. Tests were made of the service life of posts of red pine, pitch pine, Scotch pine and red maple treated by the open tank process described in previous reports. These were placed in the ground with suitable check posts under the following conditions:

Seven posts of each species—four treated and three checks—were set in a pasture fence at Middlebury in comparatively heavy soil.

Eleven posts of each species—six treated and five checks—were set in a tobacco shade tent in light, sandy soil.

All posts in the pasture fence were in good condition after two years, with the exception of one red maple check and one Scotch pine check. These showed signs of rot just above ground. In the shade tent, all the check (untreated) posts had become entirely unserviceable and had to be replaced. Without exception the treated posts remained good. It appears, therefore, that conditions under the tobacco tent favor decay but that treated posts will withstand such conditions.

Treatment of Tobacco Tent Poles

Another experiment testing the life of treated poles has been carried on for five years at the Tobacco Substation. Results of creosoting white pine, pitch pine, gray birch, red maple and popple show that: (1) Untreated poles set in the ground rot and become unserviceable in less than five years; (2) Creosote applied to the butts with a brush extends the life of the poles a short time only and cannot be recommended; (3) Treating the butts in hot creosote for three hours (open tank method) renders all species still serviceable at the end of five years; (4) The tops of the poles may be preserved by merely brushing with, or dipping in, creosote; (5) With proper treatment any of the species mentioned can be satisfactorily used for tent poles. From the standpoint of abundance, price, adaptability to treatment and physical properties, the most suitable species are red maple and pitch pine.

Post-Treating Plant Established

A commercial post-treating plant has been established by the State Forester on the Meshomasic Forest in Portland. Experimental tanks for use by the Experiment Station have been set up in connection with this plant. Although the commercial plant has been in operation for several months, there has as yet been little opportunity to use the outfit. Much experimental work will be carried on in the coming year. Therefore it seems best to delay the publication of a fuller report until these data are secured.

PLANT BREEDING

Seed of New Early Sweet Corn Ready

Seed of a number of outstanding strains of corn developed by the Genetics Department has been increased and is ready for distribution through seed companies this year. Two of these are new top crosses that have proved remarkably productive of large, well-filled ears as early in the season as the first commercial strains. Spancross C2 has been outstanding in these respects and is also highly resistant to bacterial wilt. This variety is the result of a top cross of Spanish Gold and Connecticut 2 (a Whipple inbred). A similar cross of Golden Early Market and Connecticut 6 inbred, called Marcross C6, matures a few days later but produces slightly larger ears. Spancross P39 (Spanish Gold by Purdue 39) yields a large number of medium sized, well-filled ears of excellent quality. Seed for each of these is available.

Midseason Sweet Corn Tested

As a result of several years of testing, Whipcross C6.2 appears to be most satisfactory for midseason corn. This hybrid is a first generation cross of two Whipple inbreds. The plants are uniformly productive, yielding about 10,000 marketable ears to the acre, and highly resistant to bacterial wilt. Practically the whole crop may be harvested in one day.

Adaptability and ease of producing seed recommend Whipcross P39. This is a top cross of the Whipple variety as seed parent with Purdue 39 inbred as pollen parent. It is little, if any, inferior to Golden Cross Bantam,

has a larger ear and matures three to five days earlier. It has been outstandingly productive of attractive ears of good quality; but the ears are not so uniform as in Whipcross C6.2 and are later in ripening.

Breeding Experiments Bearing on Evolution

Results of experiments crossing paired lines of inbred corn may have an important bearing on evolutionary theory. After 17 to 23 generations of self-fertilization, three inbred lines of corn were divided into two lines each and these continued by self-fertilization for five to ten generations further. Crosses between these paired lines have been made to show whether or not transmissible variations have occurred. If changes in the direction of better growth are handed down from generation to generation, the work would contribute evidence on evolution and to the analysis of growth factors.

Southern Corn High Producer Here

For the fifth successive year 1934 data confirmed previous trials showing that the late southern ensilage varieties of corn produce about 30 per cent more dry matter than the northern varieties usually grown here. Planted on the station farm at Mount Carmel, this corn grows to a height of 13 feet and green material weighed in the field amounts to about twice as much per acre as that from native ensilage. Probably this remarkable growth is not general for the whole state but only for a limited area along the coast and possibly up the Connecticut River within the upper Austral biologic zone. Most of the corn belt in the middle western states lies in this same zone. The rest of Connecticut is in a different zone, called Transitional, and in this area the southern varieties of corn would probably not give as large increases in yield as earlier varieties.

New Strain of Squash Developed

Investigators working with watermelons, field pumpkins, and cantaloupe have demonstrated that high and low yielding strains of all these cucurbits can be isolated by inbreeding and selection. These plants cross pollinate so readily when grown in the field, that in this section inbred lines can be obtained only by hand pollinating and covering the blossoms.

Our efforts with summer straightneck squash have resulted in the isolation of an early, productive, uniform strain of this variety which appears to be well adapted to New England conditions. Seed of this strain is being increased and will be available for distribution in 1936.

Better Pepper Hybrids Developed

After a number of years of work in greenhouse and field, several new hybrid peppers of the most promising quality have been developed. These are the result of crossing California Wonder with a natural hybrid from sweet Spanish pepper and Harris Early Giant. The plants are sturdy and produce prolifically and earlier than standard varieties. Fruits are of good size, blunt nosed and green, with smooth, fleshy walls. Seven tentative selections from 60 fourth generation hybrids have been made. They are to be increased and the best strain will be introduced as a new variety. In addition to the seven selections, 80 individual plants were selected for further comparison with commercial varieties in 1935.

New Strawberries Prove Superior

Approximately 400 varieties of strawberries, resulting from crosses made in 1931 and selected from 9,000 seedlings in 1932 and 1933, were fruited at Mount Carmel in 1934. Standard varieties were grown for comparison. Some of the new varieties proved superior in yield to all commercial varieties tested. About 50 of the most promising have been selected for further trial. They will be fruited at Mount Carmel in 1935. From these it is hoped to obtain a few (possibly 10 or 12) outstanding selections that will be propagated and tried out by the farmers of Connecticut and adjacent states.

Lima Beans

A pure line selection of the Fordhook bush lima bean has been tested for three years and shown to be more productive than commercial stocks of the same variety. There is a question whether this is due to an inherited difference or to the manner of growing seed. Commercial seed of lima beans is frequently injured in threshing. Being shelled by hand, the locally grown beans may have an advantage. This point is being tested.

New York Lettuce

Pure line selections of New York lettuce have failed to show consistent improvement over the original strains. The variation within the pure line far exceeds the variation among the different lines. This fact, together with the difficulty of obtaining seed in Connecticut, makes the improvement of this important vegetable crop exceedingly difficult. Crosses with other varieties have so far failed to bring out desirable heading qualities.

The variation in per cent of marketable heads of different commercial strains of lettuce during different seasons due to soil and weather conditions tends to obscure any inherent differences in the seed itself. Recommendations based on limited trials have doubtful value.

Crossed Tomato Plants

Individual plants have been selected for four generations from crosses involving Alacrity x Bonny Best x several of the standard commercial varieties. Fourteen of these selections were compared with several commercial strains this year. The best selection gave a total yield of 52,969 pounds per acre. In comparison, the next highest yielding variety, Penn State Earliana, gave 50,268 pounds. The average weight of individual fruits on the selection was 4.2 ounces, a weight highly desirable on the market. Some of the commercial varieties tested weighed more, and some less, than this. The work will be continued.

SOILS

Soil and Land Cover Inventory

The department of Soils has worked out a practical plan for mapping soils and land use throughout Connecticut by the use of the air photographs now available. During the spring of 1934, a complete airplane survey of the State was made as a project of the State Planning Board. Several years ago, the Station used an air map of Middletown as a base

in mapping the soils and land cover of that area. The experiment proved definitely that much more accurate field work may be done, in materially less time, if the area has been photographed first. Since then, several other states have experimented with air photographs in soil mapping and a considerable body of experience is now available.

With a view to undertaking a complete soil and land use survey of the entire state in the near future, an area of 30 square miles in the town of Glastonbury was selected for study of mapping technique, using the new aerophotographic mosaic (scale 1 inch = 2640 feet or 1/2 mile). As a result, a rapid practicable method of accurate mapping of soils and land use has been devised.

Increased interest in land use planning makes such a survey necessary. Planning includes not only more intelligent adjustment of agriculture to soil and topographic conditions, but the development of recreational areas, state forests, game preserves and part-time farms. A survey cannot be made with available research funds, but could be undertaken at minimum expense to the State through coöperation with federal relief agencies and the soil survey division of the United States Bureau of Chemistry and Soils. It is hoped that the work will start in 1935.

Soil Testing Helpful to Farmers

The "Universal" system of soil testing developed by this Station is proving helpful to hundreds of persons who submit samples in the course of each year. The system is constantly being standardized with the results of pot tests, fertilizer experiments and with field observations on large numbers of samples tested. The interpretations of the tests are now much improved and the Station offers a valuable service to citizens of Connecticut. Our system is now being used by numerous experiment stations, extension services and commercial agencies.

Peach Soils of Connecticut

The appearance of the baffling "X" disease of peaches two years ago led to a study of peach soils in healthy as well as in affected orchards. While no relationship between the nutritional characteristics of the soils and the occurrence of the new peach trouble has been evident, it is believed that more attention should be given to liming and fertilization in the orchards of the State, especially if satisfactory green manure and cover crops are to be grown. It is true that apparently good orchards are growing on strongly acid soils of low mineral fertility, yet it is reasonable to suppose that these trees would be better off in the future if a more favorable condition of the soil were maintained.

A series of 207 soil samples from 56 commercial peach orchards showed wide variations with respect to soil acidity and the availability of the mineral elements related to plant nutrition. The peach trouble occurred on 64 of these samples. A prevalence of strongly acid conditions and generally low availability of the plant food elements were observed.

Forty-nine per cent of the samples were more acid than 5.2 pH, and only 27 per cent showed reactions favorable for the growth of leguminous crops (5.6 pH or higher). This generally acid condition was also evidenced by unusually high active aluminum concentration, a factor which is correlated with the injurious effects of soil acidity. Phosphorus tests on 60

per cent of the samples were below levels usually accepted as normal for good agricultural soils. Potassium tests were low on 53 per cent of the samples.

More detailed chemical studies and pot experiments on 13 soils from representative orchards gave similar conclusions. Only three of these soils failed to give striking responses to phosphorus, potassium or lime, when tobacco, tomatoes and sweet corn were grown as indicator crops. All of the soils showed consistent response to nitrogen, but to a greater degree on the unlimed treatments. One soil was sufficiently acid to produce injury from excessive manganese concentration, while four soils showed striking symptoms of magnesium deficiency, when tomatoes were grown.

Market Garden Fertilizer Trials

The vegetable fertilizer experiment on the Windsor field at the Tobacco Substation has now been under way for five years. During 1934 growing conditions were especially favorable for the early crops. An early planting of lettuce showed best results from highest rate of nitrogen application (135 pounds per acre). On the later planting, maturing heads in warmer weather, a much smaller amount of nitrogen (45 pounds per acre) gave most compact heads, but the high nitrogen was distinctly detrimental to heading. As in previous years, manure alone, even in heavy application, has not been adequate for early vegetables. This is due to the slow availability of the nitrogen in manure during the spring months.

As a result of the intensive cropping that has been practiced on this field, several crops are beginning to show increased yields for the heavier rate of potash application (180 pounds K_2O per acre). During earlier years of the experiment a smaller amount of potash (120 pounds K_2O per acre) was sufficient.

Fertilizing Sweet Potatoes

The Connecticut Valley is showing increased interest in sweet potatoes and this crop is now included in the fertilizer trials at Windsor. It has been found that best quality potatoes are grown on plots receiving a low rate of nitrogen (45 pounds per acre) and high potash (180 pounds per acre). The yields of plots so treated were 410 and 443 bushels per acre respectively, in 1934. The manure treatment, with half-rate fertilization, produced the highest yields, 594.5 bushels per acre, but the crop was irregular in size and shape. In the light of these results and the experience of sweet potato growers in the main commercial districts of other states with similar soils, it is believed that manure should not be used just prior to this crop, and that the fertilizer should supply not more than 50 pounds of nitrogen, and not less than 150 pounds of potash, per acre.

Potatoes on Old Tobacco Land

For the second year potatoes have been grown at Windsor on land previously used for tobacco. The object is to find the most satisfactory rate of application of various fertilizer constituents on such soil. Due to dry weather, the average yield for the standard treatment in 1934 was only 273 bushels per acre, compared with 376 bushels in 1933. Therefore the results this year are not very significant.

However, the residual effect of former heavy fertilization for tobacco was still in evidence. The average yield without phosphoric acid (271 bushels) was only two bushels less than the standard (273 bushels) with 120 pounds of P_2O_5, while the no potash treatment gave only 254.5 bushels per acre. With 60 pounds of nitrogen per acre, the yield was 255.1 bushels, indicating that during a year of low yields the full rate of application of nitrogen (100 pounds) is not entirely utilized. The plot receiving no fertilizer of any kind during both years yielded 160 bushels per acre in 1934 as against 279.4 bushels in 1933. Additions of magnesia in 1933 gave some increases. However, unfavorable weather in 1934 made the yields so low that the soil, although relatively low in available magnesium, furnished sufficient of this element for the crop.

Acid or Alkaline Effects of Fertilizers

During recent years there has been a lively interest in the acid or alkaline tendencies of fertilizers, particularly those containing nitrogen. Much of the nitrogen in mixed fertilizers is now supplied as sulfate of ammonia or ammoniated superphosphates, materials which are known to be acid in their effects upon soil reaction. The lysimeters at Windsor have now yielded excellent data in regard to the magnitude of these effects. As measured by the amounts of acid constituents in the uncropped lysimeters, a complete fertilizer supplying 1000 pounds of nitrogen during a five year period has caused the following net losses or gains in soil bases.

The results are stated in terms of pounds of limestone ($CaCO_3$) equivalent:

Source of Nitrogen (1000 lbs. of N)	Net Change in Base Status of Soil in Lbs. $CaCO_3$
Nitrate of Soda	1095 gain
Sulfate of ammonia	3470 loss
Urea	1330 loss
Cottonseed meal	940 loss
No nitrogen	510 gain

One of the above soils, under cropped conditions (tobacco) and similarly fertilized, showed the following results, computed on the basis of difference between bases added and removed, one-half of the nitrogen in the crop being assumed as basic:

Source of Nitrogen	Net Change in Base Status of Soil in Lbs. $CaCO_3$
Nitrate of Soda	1533 gain
Sulfate of ammonia	3979 loss
Urea	721 loss
Cottonseed meal	1025 loss
No nitrogen	771 gain

One of the soils studied for five years is Wethersfield loam. At the beginning of the experiment this soil was well supplied with bases and only moderately acid. The effect of the acid type fertilizers on this soil could be calculated from the fertilizer formula. The other soils, strongly acid when the treatments were begun, were depleted in active bases to a significantly less extent than would be expected from the analyses of the drainage waters. On these soils much of the acidity produced by the

fertilizers was washed from the soil in combination with aluminum, manganese, and bases dissolved from the soil minerals that are not active under normal conditions of reaction of the soil solution.

Lime and Acid-Reacting Fertilizer

A new experiment was started in the spring of 1934 to provide data on the amount of lime required to adjust the acidity of acid-reacting fertilizers. Two soils, originally identical, were selected for tests. One was only slightly acid as a result of liming twice during the preceding five-year period. The other was strongly acid. Each was treated with sulfate of ammonia, urea, and cottonseed meal, both without lime and with amounts of lime equivalent to the theoretical acidity of the fertilizer. Nitrogen as nitrate of soda, and a "no-nitrogen" treatment also were included on each soil.

Nitrogen Recovery

With a total of five yearly 200-pound applications of nitrogen, the Windsor lysimeters accounted for nitrogen in crop removal and leaching as follows:

Source of Nitrogen (1000 lbs. of N)	Nitrogen in leaching	Nitrogen in crop*	Total Nitrogen Recovered
Nitrate of soda	763.8	373.4	1137.2
Sulfate of ammonia	680.3	243.4	923.7
Urea	498.0	322.5	820.5
Cyanamid	555.6	320.1	875.7
Cottonseed meal	432.9	285.2	718.1
Dried blood	554.3	315.6	869.9
Stable manure	370.4	175.8	546.2
No nitrogen	213.2	83.5	296.7

*Four crops only were removed, the 1929 crop being destroyed by hail.

Since serious nitrogen losses by leaching did not occur during any growing season, the nitrogen taken up by the crop was in definite relation to the amount available in the soil, except for sulfate of ammonia and cyanamid. Sulfate of ammonia produced poor crops as a result of excessive soil acidity, and cyanamid proved somewhat harmful to growth at this heavy rate of application, even though applied a month in advance of planting time.

Conservation of Fertilizer by Cover Crops

The growth of cover crops has continued to show significant results in conserving residual fertilizer nitrogen against leaching losses. The average saving due to the oats cover crop grown in the fall of 1933 was 53 pounds. In 1933–34, tobacco was followed by a fall-seeded oats cover crop. When 200 pounds of nitrogen were applied in the fertilizer, 102 pounds were removed by the crop, and only 9 pounds were lost from the soil by leaching in a 30-inch depth lysimeter. Thus a saving of 89 pounds resulted from the use of this cover crop.

Lysimeter Data from Forest Soils

The lysimeters installed in a red pine plantation in the spring of 1933 are yielding some interesting data. When the soil is kept bare at all times it absorbs and passes into the receiving pots only 30 to 50 per cent of the total rainfall recorded in the open; but when the soil is covered with natural litter, between 70 and 100 per cent is recovered.

At the end of the first year rainwater that passed only through the litter contained about 31 pounds of nitrogen per acre, of which 52 per cent was in the form of organic nitrogen, 26.8 per cent as nitrates and 21.2 per cent as ammonia. Leachate from the bare soil contained 36.6 pounds per acre of which 91 per cent was in nitrate form and only 3.3 per cent was ammonia. Where the rainfall passed through both litter and soil, it contained 63.1 pounds of nitrogen, with 87 per cent as nitrates and 7 per cent as ammonia. The late summer and fall period yielded more nitrogen than either the winter or spring and early summer periods.

Recently a set of "pan type" lysimeters was installed for the purpose of studying the leachate obtained where root competition is not disturbed by the installation. Due to utilization by the tree roots, a much smaller proportion of the rainfall and considerably less nitrogen were recovered than in the case of the original cylinder type of lysimeter in which no roots are present.

Moisture in Forest Soils

Studies of soil moisture, in relation to the moisture equivalent on forest soils sampled during the driest part of the past summer, reveal variations in relative wetness in the top six inches of soil from less than 50 in the pine plantation at Rainbow, to more than 200 in a portion of the Meshomasic Forest. The average of 86 samples from 24 mixed hardwood locations was 109.1. In general, the more favorable sites as indicated by vigor of growth and stand composition had, at the time of sampling, a relative wetness of 125 or better. The lowest value found, 25.6, was obtained in a red pine transplant bed on a coarse sand at Rainbow. For comparison, the relative wetness of a garden soil on which lettuce wilted during the hottest part of the day was 137.

Effect of Removing Litter

Removal of the litter annually by raking or burning, with and without addition of lime, has not had any consistent effect upon either height or diameter growth of a 32-year-old red and white pine plantation on the Merrimac loamy sand soil at Rainbow during the first five-year period. An extra plot which received additional litter to three times its normal amount has shown some increased growth. This thick duff maintains a higher moisture content than does duff of normal thickness, but it has had no effect on the moisture content of the underlying mineral soil.

TOBACCO

Amount of Phosphorus on New Land

A five-year field test on land not previously cropped to tobacco indicates that special carriers of phosphorus, such as precipitated bone and superphosphate, are not necessary on such land. The phosphorus supplied by cottonseed meal and other organic sources of nitrogen is sufficient for the needs of the crop. High phosphorus applications have impaired, rather than improved, quality.

Placing Fertilizer in the Row

Can the amount of fertilizer be reduced by applying it in the row instead of broadcasting as is usual? The results of the first year of an experiment on Shade Tobacco were not very promising. A reduction of one-quarter below the standard broadcast application gave poorer quality and yields. Even so small a reduction as one-eighth impaired the quality although the yield was satisfactory.

Is Starter Necessary?

For two years Broadleaf tobacco has failed to show any advantage from so-called starter in fertilizer mixtures. Most tobacco fertilizers have a small portion of their nitrogen in the form of nitrates. The purpose is to furnish immediately available nitrogen to the young plants to insure a quicker start and more continuous growth. Results on Broadleaf field plots with and without starter have failed to show any advantage of the starter either in quicker growth or in better yield or quality.

Quantity of Fertilizer Nitrogen

To apply too much nitrogen is as bad as to apply too little. A three-year field test on Havana Seed shows that plots treated with 200 pounds to the acre produced the best tobacco. Results from the use of different quantities follow:

(1) Cured leaves from the 100-pound plots are yellow, dead, chaffy and all but worthless.

(2) On the 150-pound plots these symptoms are less evident but it is clear that the quantity of nitrogen is not sufficient on this light type of soil.

(3) The 200-pound plots produced the best tobacco, with the 250-pound plots a close second.

(4) On the 300-pound plots the yield was heavier but the tobacco was coarse and showed more prominent veins, indicating excessive nitrogen.

Effects of Different Nitrogen Carriers

In 1926, the Substation began experiments on four plots of Havana Seed to learn the specific effects, when used singly, of different fertilizer materials commonly used as carriers of nitrogen. The tests now include plots of both Havana Seed and Broadleaf in two other fields, added from time to time during the past eight years. Specific differences, believed by many growers to be produced by the use of certain organic carriers, either have not been evident in these tests or, if present, have not been pronounced. Cottonseed meal, castor pomace, fish meal, linseed meal and corn gluten meal, each used as the single source of nitrogen, have produced tobacco which could not be distinguished in quality or quantity one from the other.

New Strains of Havana Seed

For several years a number of promising rootrot resistant strains of Havana Seed tobacco have been grown, compared and tested at the station farm at Windsor. This is in coöperation with the United States Department of Agriculture. Most of these strains proved to yield more than the standard types, are rootrot resistant and some have good quality. Similar reports came from farmers growing some of the strains on a larger scale. While they give much promise, their commercial value must wait the verdict of the cigar manufacturer.

Station Breeds New Cuban Shade

By breeding and selection through a period of six years, the Station has developed some new strains of Cuban Shade tobacco. In some respects these are superior to the type usually grown, particularly in leaf shape and yield. In 1934, for the first time, a small quantity of seed was supplied to growers for larger commercial trials. Reports on these have been favorable but it is too early to learn what the cigar manufacturer's reaction will be.

Disease Survey of Tobacco in 1934

During the growing season of 1934, a large number of seed beds and fields were inspected for tobacco diseases. The season in general was characterized by less disease than any recent year. In the seed beds, only one case of wildfire and one of serious black rootrot were found. Pythium damping-off was almost absent but a number of cases of the later Pythium rootrot were observed and caused severe damage in a few beds. Serious losses from fertilizer injury were also incurred in several seed beds.

Wildfire in the field was found on one farm only. Black rootrot was not serious anywhere. Brown rootrot was confined to a few fields where tobacco had followed grass or corn. Mosaic was very much less prevalent than usual, causing some damage in a very few Broadleaf fields. Leaf spots of various types became general late in the season. Pole sweat in the sheds, aggrevated by excessive dampness during the curing season, was the one serious disease of the year and ruined thousands of dollars worth of otherwise good leaf.

Investigations of leaf spots that developed late in the season showed that there were at least six different types. Two of them, wildfire and angular leaf spot, are caused by bacteria. The first appeared on one farm, while the second was more general but nowhere serious.

There were also two virus spots. The rust or fleck spots accompanying mosaic were found wherever mosaic occurred. The second virus spot, ring-spot, appeared commonly but has attracted little attention in this State. Three other types of spots, the John Williams broadleaf spot, brown spot and white speck appear to be due to physiological break-down of the leaf cells. All three were unusually abundant this season. A fungus, *Alternaria tenuis,* was found to be commonly associated with white speck and sometimes with the other physiological spots. However, considerable investigation leads us to believe that the fungus is not the primary cause of any of these spots.

Insect Pests of Tobacco

Cutworms in unusual numbers infested seedbeds this year. It was found that they could be controlled by using a poison bran bait of the kind commonly used in the fields against this insect. The hornworm became uncommonly troublesome in one Broadleaf section, calling for measures more drastic than the usual hand picking. Control experiments compared arsenate of lead dust with barium fluosilicate. Either controls hornworms but treatments should begin while the larvae are small. The larger worms are not easily killed.

Comparison of barium fluosilicate with pyrethrum dust and rotenone dust for control of flea beetles showed that all three materials are effective.

However, barium fluosilicate protects leaves for a longer time and does not need to be applied as often as the other two.

The Library

During the year ended October 31, 1934, the Station Library has had approximately the following number of additions:

U. S. Department of Agriculture bulletins and reports	939
State Agricultural Experiment Station publications	1,354
Scientific and agricultural domestic and foreign journals (separates)	2,722
Single books purchased	70
Total	5,085

The library subscribes to 85 sets of scientific journals. It receives in exchange for its own publications about 21 sets of domestic farm journals and 24 sets of foreign agricultural journals.

The total number of cloth and paper bound volumes on hand is now about 20,000. Most of the United States Department of Agriculture and State Experiment Station publications as well as journals are received in pamphlet form and are not included in the volume count until bound.

Botanical Collections

Dr. Clinton has given his large, personal collection of plants, botanical books, botanical periodicals, lantern slides, etc., to the Station. These include:

Books	175 to 200 volumes
Reprints of botanical articles, etc.	5,000
Bulletins, circulars, etc.	6,500
Lantern slides	several hundred
Botanical specimens	10,000
Letters from botanists	3,000

Projects for 1934-35

Analytical Chemistry

1. Inspection of fertilizers.
2. Inspection of feeding stuffs.
3. Inspection of foods and drugs.
4. Calibration of Babcock glassware and thermometers.
5. Analyses of insecticides and fungicides.
7. Analyses of special and miscellaneous foods.
8. Collaborative studies on analytical methods.

Biochemistry

1. Cell chemistry.
   a. A detailed examination of the nitrogenous constituents of plant cells, in particular those of leaf tissues. The further development of methods for the determination of the different forms of nitrogen in extracts of such tissues.
   b. An investigation of the constituents of the tobacco plant with special reference to the changes that occur during growth and curing.
   c. An investigation of the composition of tobacco seed.
2. Protein chemistry.
   a. The methods for the determination of the basic amino acids yielded by proteins with the object of increasing their accuracy and convenience.
   b. The methods for the separation of other amino acids yielded by proteins.
   c. The properties of certain of the amino acids and their derivatives.
   d. Methods for the preparation of pure proteins on a large scale with the object of obtaining material for chemical and nutritional study.
3. Nutrition investigations.
   a. The relation of diet to the rate of growth with special attention to certain factors that appear to determine rapid growth.
   b. The investigation of the relation of certain constituents of the diet, in particular the numeral nutrients, to growth.
   c. A study of reproduction in the Osborne-Mendell strain of white rats.
   d. An investigation of the effect of extracts of the thymus gland on the rate of growth of the offspring.

Botany

2. The nature and cause of mosaic diseases of plants.
5. Plant disease survey of Connecticut.
8. Spraying and dusting experiments on apples and peaches. (See also Entomology, No. 3).
15. A study of the virulence of the chestnut blight.
20. Diseases of shade trees.
27. Investigations of elm diseases.
28. Studies on the identification of apple varieties by seed characters.
30. Investigations on the diseases of vegetable crops and their control.
31. Investigation of a new peach trouble ("X" disease).

Control and Service

12. Seed testing. (In coöperation with Commissioner of Agriculture).
25. Spray service (with the Extension Service, Storrs).

Entomology

3. Spraying and dusting experiments on apples and peaches. (See also Botany, No. 8).
9. Insect survey of Connecticut.
17. Studies on the control of the Oriental fruit moth.
28. Investigations on oil sprays.
30. A study of insects that attack the tobacco plant. (See also Tobacco Substation, No. 20).
31. Studies on the biology and control of the European pine shoot moth. (See also Forestry, No. 13).
32. The biology and control of the potato flea beetle.
34. Tests of methods to control clothes moths.
35. The biology and control of the white apple leafhopper.
36. The control of onion thrips.
37. Substitutes for lead arsenate in orchard sprays.
38. The relation of rate of growth and pruning methods to the recovery of white pine to weevil injury. (In coöperation with the U. S. Dept. Agri.)
39. The Carpenter ant as a pest of telephone poles.
40. Studies of sprays and parasites for the control of the European Corn borer. (In coöperation with the U. S. Dept. Agri.)

Control and Service

10. Inspection of orchards and nurseries.
11. Control of gipsy moth. (In coöperation with the U. S. Dept. Agri.)
12. Elimination of mosquito nuisance.
13. Inspection of apiaries.
19. Control of the European corn borer. (In coöperation with the U. S. Dept. Agri.)
24. Control of the Asiatic beetle.
25. Control of the Japanese beetle. (In coöperation with the U. S. Dept. Agri.)
27. Rearing and distributing parasites of the Oriental fruit moth. (In coöperation with the Conn. Pomological Society.)

Forestry

1. Experimental plantations on a sandy tract at Rainbow.
   a. Comparison of many species of conifers and hardwoods, in pure stands and in combinations.
   b. Methods of management for those species that have survived.
   c. Studies on growth and habits of the several species.
2. Effect of thinning in white pine at Shaker Station.
3. Effect of thinning in hardwoods at Quassipaug Lake.
6. Studies of forest plantations throughout the State.
   a. Comparative growth of various species.
   b. Reasons for success or failure.
   c. Soil and other site factors necessary for success of each species.
10. An investigation of the distribution and growth of forest trees as influenced by soil conditions and other site factors.
11. Coniferous seed bed study to determine:
   a. The value of fertilizers in seed beds.
   b. The value of different amounts of seed.
   c. The value of dusts and sprays in preventing damping off.
12. A study of preservative treatments of native woods used for posts.
13. Studies on the biology and control of the European pine shoot moth. (See also Entomology, No. 31).
14. Studies on extensive control of the white pine weevil.

Control and Service

5. Distribution of forest planting stock. (Under Clarke-McNary Act).
7. Control of white pine blister rust. (With U. S. Dept. Agr.).
15. Control of Dutch elm disease.

Genetics (Plant Breeding)

1. A genetic study of hereditary characters in corn involving their linkage relations and variability.
2. The effects of inbreeding and crossing upon corn.
3. Methods for the improvement of naturally cross-fertilized plants by selection in self-fertilized lines, with particular attention to field corn for grain and ensilage; alfalfa; some of the more important vegetable crops, such as sweet corn for market gardening and canning, beets, carrots, cucumbers, melons, squash; and some fruits, such as bush fruits and strawberries.
4. Methods for the improvement of naturally self-fertilized plants, with particular attention to tobacco and vegetable crops such as lettuce, lima beans and tomatoes.
5. A study of variation and the effects of selection in strains of cross-fertilized and self-fertilized vegetables.

Soils

1. A descriptive inventory of Connecticut soil types in relation to their use for crops, pasture and forest.
2. The physical and chemical characteristics of important soil types in relation to the nutritive response of tobacco and other crops when these soils are variously treated in the greenhouse.
3. Nutrient requirements of vegetable crops on important soil types used for market gardening in the State.
4. A study of the physical, chemical and biological conditions of several soil types in natural mixed hardwoods and in planted coniferous forests.
5. Lysimeter studies of the drainage losses and other changes that occur in several soils under heavy fertilization as practiced for tobacco and vegetables.

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1. Fertilizer experiments—various sources and rates of nitrogen, phosphoric acid, potash, lime and magnesia.
2. Field tests with farm and "commercial" manures.
4. Tobacco nutrition studies—the role of nitrogen, sulfur, potassium, calcium, manganese, boron and magnesium.
5. Improvement of Havana seed tobacco. (With U. S. Dept. Agr.).
6. Improvement of Broadleaf tobacco.
7. Improvement of Cuban shade tobacco.
8. The effect of various winter cover crops used on tobacco land.
11. Soil reaction in relation to tobacco.
13. Preservative treatment of shade tent poles. (See Forestry, No. 12).
17. The role of humidity and temperature in curing tobacco.
19. Diseases of tobacco.
20. A study of insects that attack the tobacco plant. (See also Entomology, No. 30).
22. Irrigation experiments.
23. Studies on the rate of growth of tobacco.

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All of which is respectfully submitted,

WILLIAM L. SLATE,
Director

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